

CLAIMS

WHAT IS CLAIMED IS:

5 1. An implantable cardiac stimulation device for stimulating a heart,
the device comprising:

 a physiologic sensor that is capable of sensing a physiologic
 parameter and generating corresponding signals;
 one or more pulse generators that are capable of generating
10 cardiac pacing pulses;
 circuitry connected to the sensor that is operative to detect a
 potential sleep apnea condition based on the signals and
 that is responsive to detection of a potential sleep apnea
 condition to control the one or more pulse generators to
15 pace the heart at a sleep apnea prevention rate.

 2. An implantable cardiac stimulation device according to Claim 1
further comprising:
 a controller coupled to the one or more pulse generators and to the
20 physiologic sensor, the controller comprising an executable
 control logic that distinguishes between a sleeping condition
 and a waking condition of a patient, and controls the one or
 more pulse generators to pace at a sleep apnea prevention
 rate in response to detection of a sleeping condition.

25 3. An implantable cardiac stimulation device according to Claim 1
further comprising:
 one or more sensors that are capable of electrical coupling to the
 cardiac tissue;
30 a controller coupled to the one or more pulse generators, the one
 or more sensors, and the physiologic sensor, the controller

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including an executable control logic that controls the one or more pulse generators to pace at a rate selected from among at least a sleeping rate, a resting rate, and an exercising rate, the executable control logic being capable of distinguishing between a sleeping condition and a waking condition of a patient, and controlling the one or more pulse generators to pace at a rate greater than the resting rate in response to detection of a sleeping condition.

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4. An implantable cardiac stimulation device according to Claim 1 further comprising:

a physiologic sensor that measures physical motion for derivation of an activity parameter and an activity variance parameter, and activates sleep apnea preventive pacing when the activity and activity variance signals indicate a sleeping condition.

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5. An implantable cardiac stimulation device according to Claim 1 further comprising:

20 a physiologic sensor that measures QT interval and activates sleep apnea preventive pacing when the QT interval exceeds a threshold value.

6. An implantable cardiac stimulation device according to Claim 1 further comprising:

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a physiologic sensor that measures cardiac conductivity and activates sleep apnea preventive pacing when cardiac conductivity is depressed during sleep.

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7. An implantable cardiac stimulation device according to Claim 1 further comprising:

a physiologic sensor that measures cardiac contractility and activates sleep apnea preventive pacing when cardiac contractility is reduced during sleep.

8. An implantable cardiac stimulation device according to Claim 1 further comprising:

a physiologic sensor that measures evoked response amplitude and evoked response duration and activates sleep apnea preventive pacing when evoked response amplitude is decreased and evoked response duration is increased during sleep.

9. An implantable cardiac stimulation device according to Claim 1 further comprising:

a physiologic sensor that measures evoked response amplitude and evoked response duration and activates sleep apnea preventive pacing when evoked response amplitude is decreased and evoked response duration is increased during sleep; and

a physiologic sensor that measures paced depolarization integral (PDI) and activates sleep apnea preventive pacing when PDI is depressed during sleep.

10. An implantable cardiac stimulation device according to Claim 1 further comprising:

a physiologic sensor that measures stroke volume and activates sleep apnea preventive pacing when stroke volume increases when a patient is in a supine position.

11. An implantable cardiac stimulation device according to Claim 1
further comprising:

5 a physiologic sensor that measures paced depolarization integral
(PDI) and activates sleep apnea preventive pacing when
PDI is depressed during sleep.

12. An implantable cardiac stimulation device according to Claim 1
further comprising:

10 a physiologic sensor that measures blood oxygen concentration
and activates sleep apnea preventive pacing when blood
oxygen concentration is depressed during sleep.

13. An implantable cardiac stimulation device according to Claim 1
further comprising:

15 a physiologic sensor that measures blood carbon dioxide
concentration and activates sleep apnea preventive pacing
when blood carbon dioxide concentration is elevated during
sleep.

20 14. An implantable cardiac stimulation device comprising:
means for detecting a potential sleep apnea condition;
means for generating cardiac pacing pulses; and
means for controlling the means for generating cardiac pacing
25 pulses to pace at a sleep apnea prevention rate in response
to detection of a potential sleep apnea condition.

15. An implantable cardiac stimulation device according to Claim
14 wherein the means for detecting a potential sleep apnea condition
comprises means for detecting a sleep condition.

16. An implantable cardiac stimulation device according to Claim
14 further comprising:

means for distinguishing between a sleeping condition and a
waking condition of a patient.

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17. An implantable cardiac stimulation device according to Claim
14 wherein the means for detecting comprises at least one of:

a physiologic sensor that measures physical motion for derivation
of an activity parameter and an activity variance parameter,
and activates sleep apnea preventive pacing when the
activity and activity variance signals are reduced during
sleep;

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a physiologic sensor that measures QT interval and activates sleep
apnea preventive pacing when QT interval is prolonged
during sleep;

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a physiologic sensor that measures cardiac conductivity and
activates sleep apnea preventive pacing when cardiac
conductivity is depressed during sleep;

a physiologic sensor that measures cardiac contractility and
activates sleep apnea preventive pacing when cardiac
contractility is reduced during sleep;

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a physiologic sensor that measures evoked response integral
amplitude and evoked response duration and activates
sleep apnea preventive pacing when evoked response
integral amplitude is decreased and evoked response
duration is increased during sleep;

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a physiologic sensor that measures stroke volume and activates
sleep apnea preventive pacing when stroke volume
increases when a patient is in a supine position;

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a physiologic sensor that measures paced depolarization integral
(PDI) and activates sleep apnea preventive pacing when
PDI is depressed during sleep; and

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a physiologic sensor that measures blood oxygen concentration and activates sleep apnea preventive pacing when blood oxygen level is depressed during sleep.

- 5 18. A method of operating an implantable cardiac stimulation device comprising:
detecting a potential sleep apnea condition; and
generating cardiac pacing pulses at a sleep apnea prevention rate
10 in response to detection of the potential sleep apnea condition.
19. The method of claim 18, wherein detection a potential sleep apnea condition comprises detecting a sleeping state of a patient.
- 15 20. A method according to Claim 18 further comprising:
distinguishing between a sleeping condition and a waking condition of a patient;
timing generation of the cardiac pacing pulses; and
controlling the timed cardiac pacing pulses at a sleep apnea
20 prevention rate.
21. A method according to Claim 18 further comprising:
distinguishing between a sleeping condition and a waking condition of a patient; and
25 timing cardiac pacing pulse generation to pace at a rate greater than the resting rate in response to detection of a sleeping condition.

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